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Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

JUL 21 1995

Mr. Steve M. Alexander
Perimeter Areas Section manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 W. Fourth Avenue
Kennewick, Washington 99336-6018

Mr. Douglas R. Sherwood
Hanford Project Manager
U.S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, Washington 99352-0539

Dear Messrs. Alexander and Sherwood:

RESPONSES TO COMMENTS ON THE FOCUSED FEASIBILITY STUDY (FFS) FOR THE 100-BC-5 GROUNDWATER OPERABLE UNIT (OU)

Attached please find the U.S. Department of Energy, Richland Operations Office (RL), responses to comments on the FFS report for the 100-BC-5 OU. A comment resolution meeting during the week of July 24, 1995 is being planned.

In a U.S. Environmental Protection Agency (EPA) letter to Mr. David Olson from Mr. Dennis Faulk "Comments on 100-BC-5 FFS Report and Recommendations Regarding 100-BC-5 Proposed Plan (PP)," dated June 21, 1995, EPA recommended that RL issue a focus sheet for the 100-BC-5 OU. The focus sheet would detail out why the agencies are not pursuing a PP at this time. In the letter EPA also recommended that the 100-BC-5 focus sheet be sent out at the same time as the 100-HR-3 and 100-KR-4 PP. RL concurs that a focus sheet is a correct avenue for addressing the 100-BC-5 groundwater OU at this time. However, the schedule for the 100-BC-5 focus sheet will lag approximately one month behind the submittal of the 100-HR-3 and 100-KR-4 PP's.

If you want to discuss this matter further, please contact Mr. David E. Olson at 376-7326.

Sincerely,

Julie K. Erickson, Director
River Sites Restoration Division

RSD:DEO

Attachment:

cc w/attach:
D. A. Faulk, EPA
L. E. Gadbois, EPA
R. W. Scheck, MACTC
W. W. Soper, Ecology

cc w/o attach:
R. L. Biggerstaff, BHI
G. R. Eidam, BHI
W. E. Remsen, BHI
R. C. Wilson, BHI

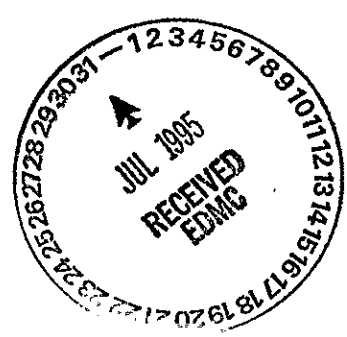
100-BC-5 OPERABLE UNIT
Responses to Regulator Comments on
the Focused Feasibility Study Report (DOE/RL-94-59, Draft A)

INTRODUCTION TO RESPONSES

The U.S. Department of Energy, Richland Operations Office (RL) has formulated the following responses to regulator comments regarding the *100-BC-5 Operable Unit Focused Feasibility Study Report* (DOE/RL-94-59, Rev. A). The majority of the questions addressed groundwater modeling; these have been addressed either individually or by the generalized "Modeling" response below. The non-modeling-related technical and editorial comments have been addressed individually. 29036

Modeling A large number of comments relate to the groundwater modeling performed, in part, to support the comparative evaluation of alternatives in the focused feasibility study (FFS). RL agrees with many of these comments, and proposed to perform additional detailed modeling, supported by site-specific hydrological testing, during the design or final feasibility study. Modeling at that time will address the comments provided. The information that was available for the FFS modeling effort was sufficient for a qualitative comparison of the alternatives, and also provided a limited estimate of the effectiveness of the alternatives. No attempt at a quantitative evaluation was attempted or intended; instead, the modeling results were provided only to lend support to a qualitative assessment of each alternative's anticipated performance. RL believes that the modeling currently presented in the FFS, when combined with the analysis against the standard *Comprehensive Environmental Response, Cleanup, and Liability Act* (CERCLA) evaluation criteria, provides an adequate comparison of the alternatives.

Qualifying text will be added to the current FFS modeling section to describe or clarify the usage and limitations of the model in supporting alternative selection.



100-BC-5 OPERABLE UNIT
Responses to Regulator Comments on
the Focused Feasibility Study Report (DOE/RL-94-59, Draft A)

FOCUSED FEASIBILITY STUDY REPORT

(The original comment numbers from the June 21, 1995 letter are in parentheses.)

GENERAL COMMENTS

1. The 100-BC-5 Focused Feasibility Study Report should be finalized and placed in the Administrative Record after comment resolution has been completed.

   RESPONSE: We concur.

2. It is EPA's recommendation that no interim action proposed plan be prepared for this operable unit. Data indicate that currently the groundwater in the 100-BC Area poses a low risk to human health and the environment.

   RESPONSE: We concur.

3. The EPA recommends that a focus sheet be prepared detailing why the agencies are not pursuing a proposed plan at this time. It should also indicate that this operable unit will continue to be monitored and after the soil is remediated in the 100-BC Area a final decision will be made on the groundwater. This focus sheet should be sent out in conjunction with 100-HR-3 and 100-KR-4 Proposed Plans Focus Sheet.

   RESPONSE: Dates by which the above actions shall be accomplished will be established by mutual agreement of RL, Ecology, and EPA following the resolution of comments.

SPECIFIC COMMENTS

4. (1) Page 2-1, Section 2.1, 1st sentence. "100-HR-3" should be "100-BC-5."

   RESPONSE: This comment has been noted. "100-HR-3" will be replaced with "100-BC-5."

5. (2) Page 2F-1, Figure 2-1. Which of the wells are the 10 "new" ones mentioned in Section 2.1? Should well B6-8 be B8-6? Also, is the location of this well correct? In the LFI it appears to be placed farther north.

   RESPONSE: The symbols in Figure 2-1 will be altered so that 10 new wells are identifiable. Well B6-8 should have been Well B8-6. The B8-6 well symbol should be located northeast of the 118-B-1 waste site.

6. (3) Page 2F-2, Figure 2-2. There are some discrepancies between this figure and the LFI. The well in the southwest corner (B8-6?) should show a value of "ND" (and should be located farther north?). Well B9-1 should have a value of 1.2J. Well B4-8 had two values in the LFI ("ND" and 1.2J). The "ND" value for B2-12 should either be removed from the map or highlighted as being from the confined aquifer. The available data for the springs should be included (see LFI). Any wells with no data should be removed from the map.

   RESPONSE: Confined aquifer wells will be identified in the legend. Spring data will be added, with footnotes indicating sample collection dates. Additionally, "non-detect" and "not analyzed" notations will be added. Well B9-1 will show 1.2J, as will B4-8. Well B8-6 will be labeled and moved northeast of the 118-B-1 waste site.

7. (4) Page 2F-3, Figure 2-32. Chromium concentration data for springs should be included. Apparently the most recent available are for 1991 (from Peterson and Johnson, 1992; WHC-EP-0609) and include three values ranging from ~12 to ~55 µg/L. Some wells are shown with no values. These should either have values added or be removed from the map.

   RESPONSE: We partially concur. The referenced 1991 data will be used. Preliminary data collected in 1994 indicate no significant changes from 1991 data.

   Wells with no detectable chromium (as determined by the analysis of samples) will remain on the map to indicate the distribution of contaminants, and labeled ND.

8. (5) Page 4-3, Section 4.3.1. A possible additional requirement might exist. At the 100-N Area, a removable barrier was mandated by a desire (from the Yakima Tribe?) to eventually return to a natural flow system in the area. A statement addressing removability of a barrier is included in the last sentence of Section 4.7.3 on page 4-14.

   RESPONSE: We agree with this comment, and will add the statement from Section 4.7.3 on page 4-14 to Section 4.3.1 on page 4-3.

9. (6) Page 4-6, Section 4.3.3, 2nd paragraph, last sentence. The possible extremely high porosities and permeabilities of the Hanford Formation could create problems with formation of a "filter cake." Are there data to indicate that this technique has worked in similar high porosity/permeability materials? If so this info should be provided.

RESPONSE: Slurry walls have been constructed in these conditions (cobble gravels). The appropriate data and references will be included in the text.

10. (7) Page 4-6, Section 4.3.3, 3rd paragraph, 5th sentence. It is stated that slurry losses into the formation are not expected due to the vertical hydraulic conductivity values. How does this effect horizontal loss? Also, the vertical hydraulic conductivity value shown is based on three laboratory tests on samples from wells. The collection of samples from wells in the 100-Area are routinely biased toward the finer-grained materials. This could lead to a date set which is not representative of the average aquifer conditions.

RESPONSE: The text will be changed. The sentence mentioned will be deleted and replaced with the following: "Losses of slurry to the formation will be controlled by slurry formulation."

Gravel greater than 2 mm in diameter is removed from samples according to permeameter testing procedure, so laboratory data would be biased. The slurry design would utilize materials and testing techniques representative of site-specific conditions.

11. (8) Page 4-7, Section 4.3.3, 2nd full paragraph, 1st sentence. The range of hydraulic conductivities given is based on three slug tests. The source of these data (DOE-RL 1993b) also states that other wells have conductivities that were too high for the slug test method. The LFI quotes a range of conductivities (for the 100 Areas) of 4.5E-5 to 2.1 cm/s (attributable to Hartman and Peterson, 1992).

RESPONSE: Site-specific conditions will be evaluated for design of the slurry.

12. (9) Page 4-8, Section 4.4, 2nd sentence. It is stated that in-situ treatment of strontium-90 is not feasible. However, at the recent 33rd Hanford symposium on health and the environment, a presentation was made on the use of an in-situ permeable barrier to strontium migration. The technique is reportedly being considered for use in the 100-N Area. Further information should be provided here.

RESPONSE: The removal of strontium from groundwater is currently being evaluated in treatability tests at 100-HR-3. The effectiveness and cost are not known at this time.

13. (10) Page 4-10, Section 4.5.2, 1st paragraph. It is stated that the placement of wells was optimized based on reduction of contaminated groundwater migration to the Columbia River, uptake (minimization of?) river water, aquifer restoration (?), and other (?)

unidentified factors. Did the optimization testing include placement of the wells parallel to the river and through the center of the plume? This would place the wells farther from the river (reducing uptake of river water) and in the area of highest strontium-90 concentration.

RESPONSE: This comment has been noted. The basic assumption of the FFS is that protection of the Columbia River is the objective. Therefore, a system that only addresses the center of mass of the plume does not meet this objective, at least not in an interim time frame. Therefore, optimization of well placement was done within the context of intercepting the plume at the river's edge and within the confines of the model. As stated in the text, further optimization would be a part of remedial design.

14. (11) Page 4-11, Section 4.5.4, 3rd paragraph, line 8. ". . . acts an . . ." should be ". . . acts as an . . ."

RESPONSE: We concur and will add "as" to the sentence.

15. (12) Page 4-14, Section 4.7.1, 1st full sentence. The use of near river well concentrations assumes that these are the maximum concentrations flowing to the river. This may not be true. These near river wells are open to the upper part of the unconfined aquifer in an area where there is potential mixing of ground water and river water (bank storage). If contaminants are present deeper in the unconfined aquifer, there is the possibility that they are carried along deeper flow lines directly to the river bottom (and are not exposed to the zone of bank storage). This information should be noted in the text.

RESPONSE: There are no data to substantiate continued deep underflow to the river (in the absence of a high head mound in the water table as a driver). The near river well concentrations are the maximum measured concentrations from the monitoring well network adjacent to the river. Therefore, the possibility of high contaminant concentrations moving along deeper flow lines will not be discussed in the text.

16. (13) Page 4F-1, Figure 4-1. The location of the cross-section should be drawn in a map view. Lithologies "SPCA" and "S G" are used for well B2-12 but are not included in the key. Lithologies "BF," "SZG," "ZG," "Z/CA," and "GSZ/" are included in the lithologic key but are not used in the figure. Also, "backfill" is listed as a geologic unit in the key but does not appear in the figure.

RESPONSE: The figures will be edited so that all units appearing in the figure are included in the key and units not appearing in the figure are deleted from the key.

17. (14) Page 5-1, Section 5.1.1.1, 2nd sentence. It is stated that MODFLOW was selected based on DOE-RL 1991b. This reference does not specify MODFLOW as a "recommended" code.

RESPONSE: The reference to DOE-RL (1991b) will be deleted. The sentence will be rewritten to read as follows: "MODFLOW is capable of simulating the unconfined aquifer using a personal computer."

18. (15) Page 5-1, Section 5.1.1.2, 3rd bullet. The assumption of uniform streambed thickness is not needed. The modeling approach (using CRIV, see page 5-4) uses head loss between the aquifer node and the river, not a head loss across the streambed. Also, the assumption of uniform depth of the river is not warranted. River bottom altitudes are available ("Columbia River Navigation Studies - 1986" by the USACOE). The available data indicate that the river bottom altitude is about 365 to 370 ft for most of the 100-B/C Area but includes a very deep area (altitude about 345 ft) just upstream of the operable unit (near river mile 384.7). For the purposes of the modeling in this document the values of river bottom altitude play a part in the formulation of the river conductance values.

RESPONSE: Please refer to the "Introduction to Responses." The MODFLOW users manual (McDonald and Harbaugh, 1988, pg. 6-6) states that if reliable field measurements of stream seepage and associated head difference are not available, the conductance value (CRIV) must be chosen arbitrarily and adjusted during calibration. Since the CRIV term is empirical and linear in the variables representing streambed thickness and river depth, only changes in the product term (CRIV) affect the results.

19. (16) Page 5-2, Section 5.1.1.2, last sentence. The modeling results are stated as being conservative because the mixing zone was not simulated. However, the use of an average river stage ignores the possibility of high river stages which may mobilize contaminants in the vadose zone. The non-conservative nature of this aspect of the modeling should be stated.

RESPONSE: The text will be changed such that both conservative and non-conservative aspects of the modeling are identified.

20. (17) Page 5-2, Section 5.2.1, 1st sentence. Simulating the flow system in a single layer requires the assumption that there is no significant vertical head gradient in the unconfined aquifer. This assumption should be stated as well as any evidence to support its validity.

RESPONSE: Please refer to the "Introduction to Responses."

21. (18) Page 5-3, Section 5.2.3, 2nd sentence. The head elevations used along the constant-head boundary should be shown in a figure.

RESPONSE: We agree with this comment. A new figure will be added.

22. (19) Page 5-3, Section 5.2.4, 1st sentence. The map of the bottom of the aquifer should be shown in a figure.

RESPONSE: We agree with this comment. A new figure will be added.

23. (20) Page 5-3, Section 5.2.5, 2nd sentence. The recharge rate used (determined by calibration) should be supported by other information. For example, the 1993 ground-water monitoring report (PNL-10082) shows a recharge map indicating a range from 0.5 to 5 cm/yr for the 100-B/C Area.

RESPONSE: Please see the "Introduction to Responses."

24. (21) Page 5-3, Section 5.2.6, 2nd and 3rd sentences. It is stated that in the LFI, hydraulic conductivity was given as >15 ft/d. The LFI (p. 2-6) actually says that hydraulic conductivities from slug tests were determined to be 2, 15, and 50 ft/d in the three wells tested. Also, the LFI states that in other wells the slug-test data could not be interpreted; the likely reason being greater hydraulic conductivity values in these wells.

RESPONSE: Please see the "Introduction to Responses."

25. (22) Page 5-3, Section 5.2.6, last sentence. The conductance of the bottom of the model is given as 22 ft^2/d. In MODFLOW the conductance is calculated by the equation Conductance = (vertical hydraulic conductivity)(cross-sectional area)/(confining bed thickness). Using a thickness of 110 ft (p. 2-3 LFI) and a cross-sectional area of 82 ft x 82 ft, results in a vertical hydraulic conductivity of 0.4 ft/d for the confining bed. The few available vertical conductivity values are more in the 1x10E-4 range (Liikala 1988 and Delaney 1991).

RESPONSE: Please see the "Introduction to Responses."

26. (23) Page 5-4, Section 5.2.7, 1st sentence. It is stated that a storage coefficient and a porosity were input to the model. In simulating an unconfined aquifer, MODFLOW uses only a single storage term, which should be a specific yield value. If the confined layer option is used in MODFLOW for an unconfined aquifer (appropriate only where changes in saturated thickness are very small relative to total saturated thickness), a specific yield value should still be used (although the input parameter is called storage coefficient). The storage coefficient of 0.02 appears to be much too low for an unconfined aquifer. Small values like this sometimes are calculated from aquifer test data in unconfined aquifers. However, in analyzing test data from unconfined aquifers, the assumptions used can lead to calculated storage values which are not realistic (even though the hydraulic conductivity values are considered reasonable).

RESPONSE: Please see the "Introduction to Responses." The text will be changed to remove the ambiguity about the parameters and where they were used.

27. (24) Page 5-4, Section 5.2.8, 2nd paragraph. It is stated that November 19, 1993 river stages were used. However, on page 5-2 it is stated that average river stages were used. If the November 19, 1993 stages are indeed "average" this should be demonstrated (show plot of November 19 vs. annual trend?). The river stage values used should be explicitly indicated (figure?). Also, the river depth used (13 ft) is probably too small. From available data (see comment on Page 5-1, Section 5.1.1.2, 3rd bullet), the river depth ranges mostly between about 16 and 21 feet with a maximum of about 42 feet.

RESPONSE: Please see the "Introduction to Responses."

28. (25) Page 5-4, Section 5.2.8, 3rd paragraph. The formula given is not exactly correct. CRIV is not an exact equivalent of KLW/M. CRIV is used in MODFLOW where the head loss between the aquifer and the river does not occur primarily across a discrete streambed layer but is more gradually distributed throughout the aquifer. When CRIV is used, M (streambed thickness) should be replaced by the distance from the center of the aquifer (node location) to the streambed.

RESPONSE: Please see the response to (15). The formula as shown is from the MODFLOW manual, and the text will be changed to reflect the reviewers comments.

29. (26) Page 5-4, Section 5.2.8, last paragraph, last sentence. It is stated that vertical hydraulic conductivity was determined by calibration. It is more accurate to state that the conductance term (CRIV) was determined by calibration.

RESPONSE: The sentence will be changed to reflect the reviewer's comment.

30. (27) Page 5-5, Section 5.2.9, 1st paragraph, 1st sentence. It is stated that the model was calibrated to water levels and river stages. The river stages are input parameters and do not change during the simulation, therefore the model cannot be calibrated to these values. How were the water levels used in calibration? Were simulated values at each well compared to measured values or were contours compared? The method used (preferably well by well, not contours) should be indicated and a table or figure showing simulated vs. measured water levels should be included. In addition to calibrating to water levels, the model should be calibrated to flows. In this instance flows are not well known, but reasonable limits can probably be determined. The calibration process should include checks of the validity of the calculated flows. Also, the simulated water budget should be included in this document. Also, do the November water levels represent "average" conditions?

RESPONSE: Please see the "Introduction to Responses." The text will be changed to reflect the reviewer's comment.

31. (28) Page 5-5, Section 5.2.9, 2nd paragraph, 1st sentence. The stated process of varying three different parameters (four if vertical flow is added) during the calibration may not be the best procedure. The better known parameters (recharge and hydraulic conductivity?) should be held constant while the lesser known parameters (river bed conductance and vertical flow?) should be varied during calibration. Also, was any sensitivity testing conducted?

RESPONSE: Please see the "Introduction to Responses."

32. (29) Page 5-5, Section 5.2.9, 2nd paragraph, last sentence. It is stated that flow into the bottom of the aquifer was used in the calibration process. Somewhere there should be a presentation of the evidence for this phenomenon (e.g., PNL-10082 shows upward vertical gradients from the basalts to the unconsolidated units of about 0 to 3 meters).

RESPONSE: Please see the "Introduction to Responses."

33. (30) Page 5-5, Section 5.3.1.1, 1st sentence. MT3D is not listed in DOE/RL-91-44 as a recommended code.

RESPONSE: We agree with this comment. The sentence will be changed to remove the inference that DOE/RL-91-44 recommends MT3D.

34. (31) Page 5-5, Section 5.3.2, 1st paragraph, 1st sentence. It is stated that the model was calibrated to observed January 1993 strontium-90 concentrations. Was the comparison of simulated to observed based on well by well values or contours? Are there any data on strontium-90 concentrations through time? If so, the calibration should include a

comparison of observed concentrations through time vs. simulated concentrations through time; not just January 1993 values.

RESPONSE: Please see the "Introduction to Responses."

35. (32) Page 5-6, Section 5.3.2, 2nd paragraph, bullets. In addition to the stress periods shown, the rates of stress (concentrations/flow rates) should be shown.

RESPONSE: Please see the "Introduction to Responses."

36. (33) Page 5-6, Section 5.3.2, 3rd paragraph, 1st sentence. It is stated that a solution from a transient flow model was used. In the previous discussion on the flow model, no information is given relative to transient simulations (everything apparently pertained to a steady-state simulation). How was the system altered in the transient formulation? If the injection rates are meant to recreate the fluid/contaminant releases of the past, then the flow model should be calibrated in the transient mode (comparing the simulation to the observed heads/flows that occurred during the period of mounding).

RESPONSE: Please see the "Introduction to Responses."

37. (34) Page 5-6, Section 5.3.2, 4th paragraph, 2nd sentence. It is stated that a strontium-90 retardation factor of 213 was used. What is the source of this value? Ongoing modeling efforts in the 100-N Area are using a factor of 100.

RESPONSE: Please see the "Introduction to Responses."

38. (35) Page 5-6, Section 5.3.2, last paragraph, 3rd sentence. It is stated that simulated strontium-90 concentrations were compared with the January 1993 observed concentrations. The simulation represents the aquifer in a single layer. This assumes that the concentration of strontium-90 is evenly distributed vertically throughout the aquifer. Can this assumption be supported?

RESPONSE: Please see the "Introduction to Responses."

39. (36) Page 5-7, Section 5.4.2, 3rd paragraph, last sentence. Is the well discharge rate shown a rate per well or a total?

RESPONSE: Please see the "Introduction to Responses." Text will be added to reflect the reviewer's comment.

40. (37) Page 5-7, Section 5.4.2, 3rd paragraph, last sentence. Discharge rates of 100 gpm (per well?) were input to the model. MODFLOW calculates a water level only for the

entire model cell (82 ft by 82 ft). Were calculations made of the expected drawdown at each well? Is there enough available drawdown at the withdrawal rates used?

RESPONSE: Please see the "Introduction to Responses."

41. (38) Page 5F-2, Figure 5-2. Based on this map (not having seen any simulations for any earlier time periods), it appears that the model is indicating very little movement of strontium-90 from the source areas. Some of the existing data do not confirm this. For example, the LFI data indicate a value of 16 pCi/L at well B5-2 and a value of 6.3J at spring 039-2, which in the simulation apparently have values of <10 (and perhaps nearly 0?). The existing data seem to indicate a much wider movement of strontium-90 than the simulation apparently shows. Also, there are several unlabeled contours.

RESPONSE: Please see the "Introduction to Responses." The contours will be labeled.

42. (39) Pages 5F-2 through 5F-14, Figures 5-2 through 5-14. The titles should include the date simulated (present scenario = January 1993?, and future scenarios = 2008? and 2018?).

RESPONSE: We agree with this comment. The figures will be amended as noted.

43. (40) Pages 5F-6 and 5F-11, Figures 5-6 and 5-11. The labels on the contours are apparently missing the tenths of meters.

RESPONSE: We agree with this comment. The figures will be amended as noted.

44. (41) Page A-5, Section 2.2, 2nd paragraph, 3rd sentence. The list of parameters with upgradient concentrations greater than near-river concentrations is not complete (based on the data in Table A-1). Alkalinity, chloride, conductivity, nitrate, sulfate, TDS, and TOC should be included.

RESPONSE: For all indicator parameters except total organic carbon (TOC), upgradient and downgradient values are remarkably similar and are not appropriate for inclusion in the page A-5 discussion. TOC did exceed the downgradient values for at least one sample. This variability is not explained, but can be included in the discussion on page A-5 following a review of the data.